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None

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F4S

(54) Heat exchangers

(57) A heat exchange tube is a light alloy multi-bore extrusion having the walls of the bores dimpled, with the dimples on opposite walls aligned so that each bore consists of a series of chambers along its length, the chambers being connected together by the restricted portion lying between the pair of dimples, and this gives the effect of high turbulation and most efficient heat exchange.

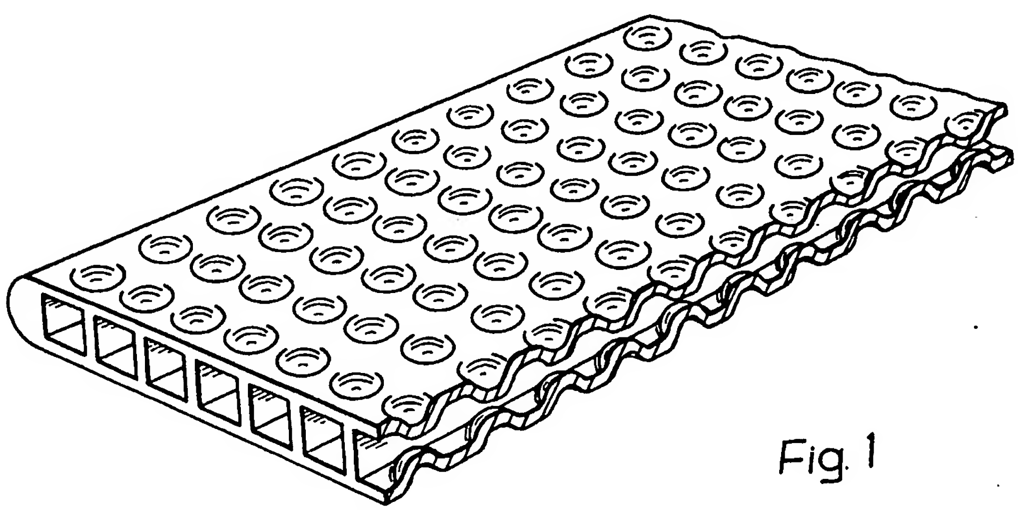

Fig. 1

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The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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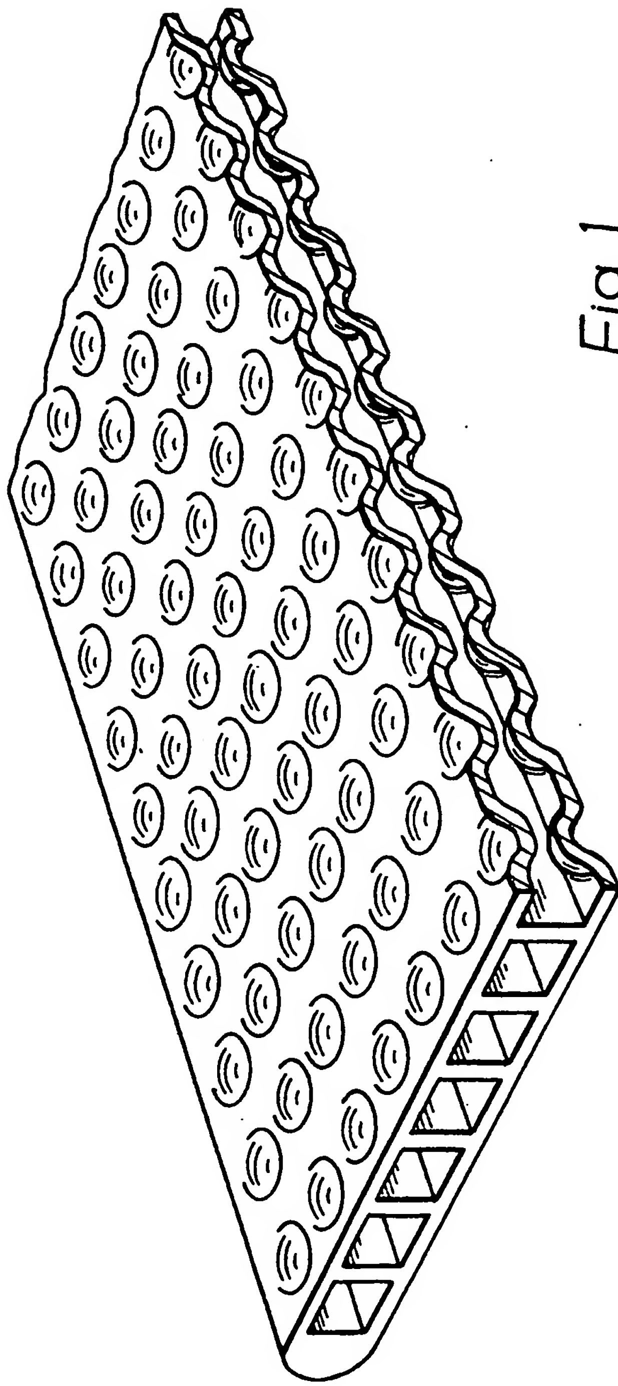

Fig. 1

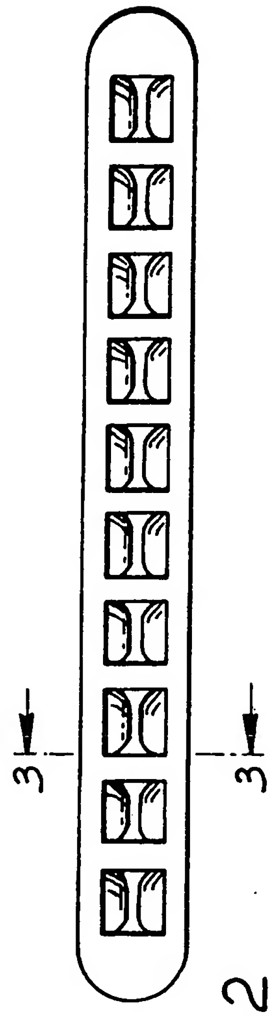

Fig. 2

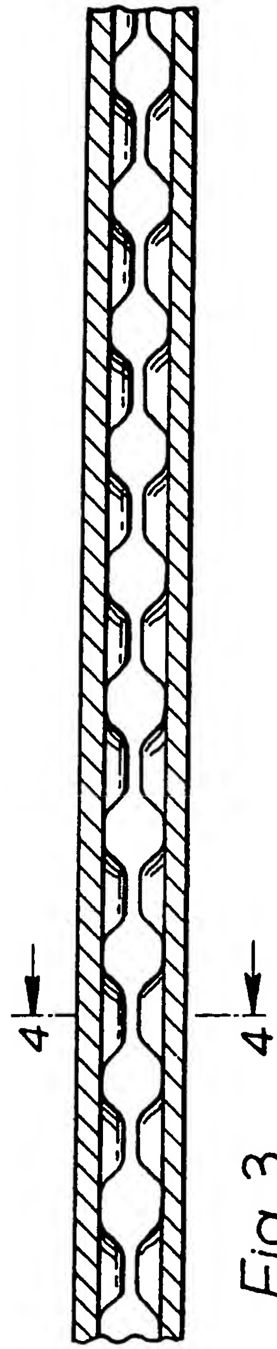

Fig. 3

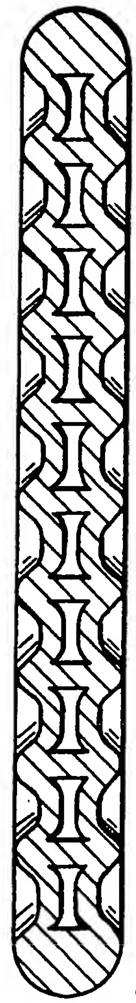

Fig. 4

SPECIFICATION

Heat exchangers

This invention relates to heat exchangers. It is known to improve heat exchange by providing passages for fluid (particularly liquid) flow which have non-linear walls, for example in GB 2090651A there is a suggestion for an extruded light alloy tube having passages of substantially square cross-section, with the passage walls being dimpled alternately along the length of the passage, so that the inwardly extending dimples form a passage of sinuous shape and of substantially constant cross-section along the length of the passage.

The multi-bore light alloy extrusion mentioned in said prior Patent has been manufactured successfully and has been found to give highly efficient heat exchange. Moreover, the manufacturing process is relatively simple involving pressing or possibly rolling tube so as to dimple the extrusion.

However, difficulties have been encountered from an unexpected source in that as the extrusion dies wear (it is an inevitable result of large scale manufacture) the wall thickness of the tubes increases and the passages reduce in cross-sectional area. This is because the die pegs which form the passages wear most rapidly. For economical production it is necessary to set upper and lower limits, i.e. start with a die giving thin walls and large passages, and end when a certain thickening and reduction have been reached. Using a standard dimpling technique, dimples of different and non-standard depth into the passages have been produced depending on whether it is thick-walled tube from a worn die or thin-walled tube from a new die, and the sinuosity of the tube has varied. Thus, for example, if the tube wall is very thick and the material is soft the dimple may hardly form any indentation into the tube bore at all. It has been found that the limits for useful results with the invention of said prior Application are much narrower than are economically desirable for die replacement.

The present invention is based on a surprising and chance discovery in relation to these extruded light alloy multi-bore heat exchanger tubes having dimples in the parallel walls.

According to the invention, an extruded light alloy multi-bore heat exchange tube having substantially planar and parallel walls has said walls dimpled to form inward projections into its tube bore, and is characterised in that the dimples in one wall are aligned with the dimples in the opposite wall so that in median longitudinal section the bore consists of a series of chambers connected together by restricted portions, each restriction lying between a pair of dimples extending inwards from opposed walls.

Preferably the dimples are closely spaced along the length of the passage so that each of said parallel walls is effectively sinusoidal.

The invention thus departs from the idea of using sinuosity to produce turbulence; instead it uses pressure variations. Hence the location of the dimples in opposed pairs is fundamental. Because of this, and because restriction of passage width is required (instead of being disadvantageous and discouraged as in the said prior specification) a greater tolerance in wall thickness is possible.

The invention is further described with reference to the accompanying drawings in which:–

Figure 1 is a perspective part sectional view of a portion of a multi-bore heat exchange tube according to the invention;

Figure 2 is an end elevation of the same;

Figure 3 is a longitudinal section along the line 3–3 of Fig. 2; and

Figure 4 is a cross section taken on the line 4–4 of Fig. 3.

Referring to the drawings, the heat exchange tube is extruded with parallel top and bottom faces and a series of, for example, ten parallel square cross section straight flow passages lying between said top and bottom walls.

Both faces of the tube are dimpled, that is to say with generally hemispherical projections inwardly of the passages. The dimples are in lines, that is to say their axes are contained in common planes each of which planes is normal to the top and bottom faces of the tube and each said plane bisects an individual passage so that the dimples are symmetrical with respect to the width of the passages.

The dimples are also aligned in rows transversely of the length, that is to say their axes are contained in planes parallel to one another and each plane being both normal to the top and bottom surfaces of the tube, and the parallel planes being regularly spaced apart along the length of the tube, each said plane containing the axes of dimples on both the upper and lower (as illustrated) faces of the tube.

Fig. 1 has one passage sectioned medianly, and shows that in the median plane each passage is provided with a series of constrictions.

As will be seen from Fig. 2 for example the restrictions are at a maximum in the median plane of the passages, and at minimum at the lateral sides of each passage. In fact by using dimples of suitable dimensions, each passage can have a lateral wall which is effectively bounded by parallel edges. However, using the dimple form shown, the lateral walls also vary in effective width exposed to the fluid flowing in the passages but with less variation than there is at median section.

The provisions of dimples which are aligned with one another (from the opposite faces)

instead of alternating as in the mentioned prior art, has two different results. Firstly, because the dimples can be formed in pairs, that is to say the dimples in the top face can be formed at the same time as the dimples in the opposite face, it is an easy matter to control the depth of the dimples and to ensure that a relatively uniform product is achieved irrespective of their variations in wall thickness.

However, the second effect is more surprising in that it is found that the efficiency in terms of heat exchange rate is relatively constant even for dimples of variable depth, and it is thought this may be due to a particularly efficient turbulation being introduced into the flowing fluid because of the cross sectional shape of the passages. In practice, it has been found that heat exchange rates can be achieved with a tube as shown in the drawings equal to the best that can be achieved in the mentioned prior art.

The dimples need not be of hemi-spherical shape, but such shape is preferred.

CLAIMS

1. An extruded light alloy multibore heat exchange tube having substantially planar and parallel walls and also having said walls dimpled to form inward projections into tube bore, characterised in that the dimples in one wall are aligned with the dimples in the opposite wall so that in median longitudinal section the bore consists of a series of chambers connected together by restricted portions, each restriction lying between a pair of dimples extending inwards from opposite walls.

2. A tube as claimed in Claim 1 wherein the dimples are closely spaced along the length of the passage so that each of said parallel walls is sinusoidal.

3. An extruded light alloy multi-bore heat exchange tube substantially as described with reference to the accompanying drawing.

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